

## RECENT MATHEMATICAL WORKS

*An Elementary Treatise on the Dynamics of a System of Rigid Bodies, with Numerous Examples.* By E. J. Routh, M.A., F.R.S., F.R.A.S., F.G.S. Third Edition, Revised and Enlarged. 8vo, pp. 564, xii. (London: Macmillan and Co., 1877.)

*A Treatise on Statics, containing some of the Fundamental Propositions in Electro-Statics.* By G. M. Minchin, M.A. 8vo, pp. 450, xii. (Longmans, 1877.)

*Lectures on the Elements of Applied Mechanics, comprising (1) Stability of Structures; (2) Strength of Materials.* By M. W. Crofton, F.R.S. Printed for the Use of the Royal Military Academy. Pp. 107. (C. F. Hodgson and Son, 1877.)

*Handbook of Natural Philosophy—Mechanics.* By D. Lardner, D.C.L. New Edition, Edited and considerably Enlarged, by B. Loewy, F.R.A.S. Pp. 489, xxii. (Crosby Lockwood and Co., 1877.)

*The Book of Mechanics. Part I.—Statics.* By R. Oscar Thorpe, M.A. (Stewart's Local Examination Series, 1877.)

THE main features of Mr. Routh's admirable treatise are well known to students. The first edition, of 336 pages, appeared in 1860; the second, of 492 pages, in 1868; the present consists of 564 pages, each page containing from a third to a half as much matter more than the page of the earlier editions. Some idea may thus be formed of the great amount of new matter. Of this increase take another proof: in the second edition the chapter on *Small Oscillations* took up pp. 273 to 322; in this edition the subject occupies pp. 325 to 403! The author assigns as a reason for this increase, "I have been led" to make these additions "because there are so many important applications which it did not seem proper to pass over without some notice."

An interesting feature is the increased number of historical notices, though these are confessedly very slight, drawn from Montucla (by a misprint Montuela), Prof. Cayley's Report on Theoretical Dynamics (British Association Report, vol. xxvi.), and other sources. Some of these are relegated to an appendix. A great number of original memoirs have been consulted and some of these of very recent date. We do not notice in Articles 282, 475, in which a discussion of the problem of Laplace's three particles is given, any reference to the author's paper on the subject in the *Proceedings* of the London Mathematical Society (vol. vi. No. 81, pp. 86-97), though of course the substance of this paper is given in the text. We note this, because in both places Mr. Routh cites a reference, by M. Jullien, to a Thèse de Mécanique, by M. Gascheau, which he has not succeeded in verifying. Perhaps a notice of this point in NATURE may lead to the matter being cleared up for Mr. Routh's satisfaction. We have not ourselves met with this pamphlet by M. Gascheau. We could dwell much longer on this fine work, pointing out the numerous places where new proofs are given and entirely new matter is introduced, but we need only say that it must claim a very high place in our mathematical literature, and go far to remove the reproach brought against Cambridge text-books by students who have become familiar with the works of continental mathematicians. There is an ample and diversified col-

lection of problems which are given in the several chapters and appended to them. Following a common practice, the author gives a list of articles to which beginners should first turn their attention.

Prof. Minchin purposely omits the prefix "Elementary," his main object being to give "a tolerably comprehensive view of statics." Very early in his book he introduces the conception of "virtual work," a term he adopts from the best French writers (Collignon, Delaunay, and others) in preference to "virtual velocities." His reason for bringing the subject so soon before the student is "the conception of work is the most prominent in modern physics, and, therefore, at the risk of being charged with prolixity, I have shown in the earliest chapters how all the conditions of equilibrium of a system may be obtained from the principle of virtual work independently of the usual mode of the reduction of forces." Graphic methods are used in the earlier portions; a good feature, now that the treatises of Culmann, Bauschinger, and Cremona are in the hands of many English students. The subjects treated of are much the same as in other treatises in our hands, and the last chapter (pp. 403 to 450) is devoted to the theory of the potential; the modes of treatment, however, are different.

Prof. Minchin attaches great importance to the solution of problems, and so takes care to solve a great many leading cases, and has done good service to students by these solutions and by the figures which he gives. The following remarks speak for themselves:—"It is characteristic of the system of 'cramming,' which has been called into existence by modern competitive examinations, that the *applications* of mathematics, as exhibited in the solution of examples, are greatly neglected. A cause contributing to this objectionable system appears to me to exist in our mathematical treatises, many of which are almost wholly filled with unsolved problems and dry 'book-work,' which the student never learns to apply. I have therefore very largely illustrated the principles of the subject by solved examples, and I have attached at least as much importance to examples, all through, as to the abstract principles which they illustrate."

We cordially commend the book, and hold that it is no unworthy companion of such text-books as those of Dr. Salmon and of Mr. Williamson.

Prof. Crofton's book is a "Synopsis of a Course of Lectures on the Elements of the Theory of Structures and the Strength of Materials, forming the First Part of the Course of Applied Mechanics at present studied by the Gentlemen Cadets of the Royal Military Academy." The book requires to be read with some care, as the author's idea is that it should be supplemented by *viva voce* instruction and by experimental illustrations. It is thoroughly elementary, however, and avoids all aid from the differential and integral calculus. Great importance has been deservedly attached to the elegant method of diagrams of forces and to Culmann's graphical method. In the first part are considered such matters as frames, roofs, trussed beams, chains, and cords, and the stability of walls. In the second part come under notice resistance to stretching and to compression, theory of beams, moment of resistance in rectangular beams, girders, open girders, partially loaded beams, and other thoroughly practical matters. Prof. Crofton has wisely given a great

number of figures, and in addition to numerous unsolved exercises, has given very many worked-out problems. In his introduction he points out that "the practical man, unlike the theoretical, cannot choose his problems; he must take those which the requirements of his art present, whether elegant and curious, or cumbrous and repulsive. Moreover, in his case, *some* solution of every problem must be obtained; if he is unable to find a rigorous scientific solution he must make some further assumptions or have recourse to experiment; he cannot lay the question aside." He goes on further to point out the differences between the two studies of theoretical and applied mechanics. The author has brought the subject before the notice of mathematicians in communications to the Mathematical Society and the *Educational Times*.

Mr. Loewy has retained much of the elementary part of the late Dr. Lardner's treatise, having carefully revised it and brought it up to modern requirements. He has re-written, for the most part, the descriptive chapters on machines, clockwork, &c. Many new illustrations and a great number of solved exercises have been added, so that now the work is embellished with nearly 400 illustrations. An account is given of the modern units of force and work (the dyne, poundal, &c.). The result is a neat and readable book on properties of matter, theory of machinery, and illustrations of the application of mechanical principles in the industrial arts. We do not pretend to have read the work for it is full of matter, but what we have examined we have found interesting and carefully done. We have detected a few slips (typographical, chiefly) in the solutions. A good feature is an index.

The last book on our list is neatly got out and is doubtless adapted for the end in view, the author having written it for candidates for the Oxford and Cambridge Local Examinations. It is such a book as might have been compiled at any time within the last twenty-five years from the Cambridge text-books, for it keeps quite to the old Cambridge "lines;" it "aims at being simple, but not childishly so." The modern treatment of the subject has been altogether avoided. This is, perhaps, no fault of the author, but rather the exigencies of the above-named examinations have compelled him to move in this rut. There is a sufficient number of exercises taken from the examination papers, and a chapter is devoted to hints for, and examples of, the selection of problems. The figures generally are clearly drawn, but a cylinder on p. 43 is a sorry representation of such a solid.

#### OUR BOOK SHELF

*Mikrographie der Glasbasalte von Hawaii: Petrographische Untersuchung.* Von C. Fr. W. Krukenberg. (Tübingen, 1877.)

THE interesting facts made known of late years by Prof. Möhl, of Cassel, and Dr. Bořický, of Prague, as the result of their study of the microscopic characters of the vitreous and semi-vitreous rocks of basic composition, have rendered it eminently desirable that a thorough investigation of the remarkable lavas of the Sandwich Islands should be undertaken by some competent observer. We therefore hail the appearance of the monograph now before us as supplying a want which has been felt for

some time past by all who are interested in micro-petrographic studies.

From the older analyses of the Sandwich Island lavas as tabulated by Herr Krukenberg, we learn that the composition of these rocks varies within very wide limits—the proportion of silica ranging from 39.74 to 59.80; the author's own analyses, however, would seem to indicate much less widely separated rocks as having been subjected to examination by him, for the proportions of silica are given as from 50.865 to 53.61. The most remarkable circumstance about the composition of these Hawaiian lavas is probably the large proportion of iron-oxide which they contain, the percentage of this substance ranging from 13 to 33 per cent., while alumina is only present in small quantity, or is sometimes altogether absent.

Herr Krukenberg first describes the curious structure revealed by the microscope in the compact basaltic glass in which are detected numerous beautiful examples of those skeleton crystals built up of crystallites to which Vogelsang first directed the attention of geologists, and to which the name of "chiasmoliths" has been applied. Among the perfectly-formed crystals porphyritically embedded in this compact or glassy mass, the author noticed feldspar (both orthoclasic and plagioclastic) and olivine, but he failed to detect augite.

The curious forms assumed by the threads of Pele's hair are admirably described in the work before us, and are illustrated by numerous figures. Gas bubbles appear to be very common in these glass threads, and they are often drawn out into elongated cavities or fine capillary tubes. Minute crystals are sometimes seen in the midst of the glass threads, which sometimes exhibit a concentric structure and at others a series of transverse striations. In the ordinary porous glass lava the author finds structures intermediate between the chiasmoliths and the crystalline plates seen in Pele's hair; his drawings, indeed, very admirably illustrate the mode of development of crystals in glassy magmas. The last variety of the Sandwich Island lavas described in this monograph is the sphaerulitic; but the sphaerulites of the basaltic rocks do not appear to differ in any essential point of structure from those so well known as occurring in acid vitreous rocks.

In an appendix to the paper the author notices the existence in the Sandwich Islands of a true obsidian which yielded 76.10 per cent. of silica. The monograph is illustrated with four lithographic plates, and is a very valuable contribution to petrographic science. J. W. J.

*Preventive Medicine in Relation to the Public Health.* By A. Carpenter, M.D., C.S.S., Camb. (London: Simpkin, Marshall, and Co.)

UNDER the title of "Preventive Medicine" Dr. Carpenter has reprinted lectures which he gave, during the summer session of 1876, at St. Thomas's Hospital. They were addressed to students, and the form in which they were first given has been preserved. At a time when, in the words of the Prince of Wales's letter to the Society of Arts, "the supply of pure water to the population is exciting deep interest throughout the country," the volume will be found a convenient and ready *résumé* for those who wish to inform themselves on the more important questions that enter into the consideration of what is a good water supply, and what is to be done with fouled water. As is well known, Dr. Carpenter advocates sewage-farms as the proper way to dispose of sewage, and the chapters devoted to this subject enter into financial as well as scientific consideration. In speaking of the spread of epidemic diseases by water and by air Dr. Carpenter explains the germ theory, but we cannot find that he even alludes to any other possible explanation. It appears as if he regards the germ theory of disease as really *proved*. Is it?